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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
WATKO, JULIE ANNE	
ART UNIT	**PAPER NUMBER**
2653	

DATE MAILED: 09/30/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/671,160	COVINGTON, MARK	
	Examiner	Art Unit	
	Julie Anne Watko	2653	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-34* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *23-33* is/are allowed.

6)☒ Claim(s) *1-4,6-8,12-20,22 and 34* is/are rejected.

7)☒ Claim(s) *5,9-11 and 21* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *09/25/2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *09/25/03, 03/01/04*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☒ Other: *IDS 12/06/2004*.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claim 17 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 17 recites the limitation "the nonmagnetic metallic spacer layers" in line 2. There is insufficient antecedent basis for this limitation in the claims. Only one nonmetallic spacer layer has been previously recited.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-2, 4, 8, 12-14, 16, 19-20, 22 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhu ("Thermal Magnetic Noise and Spectra in Spin Valve Heads", 15 May 2002, J. Applied Phys., v. 91, no. 10, pp. 7273-7275) in view of Katine et al ("Current-Driven Magnetization Reversal and Spin-Wave Excitations in Co/Cu/Co Pillars", 3 April 2000, Phys. Rev. Let. v. 84, no. 14, pp. 3149-3152).

As recited in claim 1, Zhu shows a method of reducing noise due to thermally activated spin waves in a magnetoresistive element including a free layer (including CoFe(10), see p.

7273, section II), a reference layer (including CoFe(20)), and a spacer layer (Cu(18)), the spacer layer positioned between the free layer and the reference layer, the method comprising: pinning (via AFM) a magnetization of the reference layer in a fixed direction; and directing a current perpendicular to a plane of the free layer, reference layer, and spacer layer.

As recited in claim 1, Zhu is silent regarding directing a spin polarized current such that the current exerts a spin momentum transfer torque on localized electron spins to reduce noise due to thermally activated spin waves.

As recited in claim 1, Katine et al show directing a spin polarized ("spin-polarized current", see p. 3149) current such that the current exerts a spin momentum transfer torque on localized electron spins to reduce noise due to thermally activated spin waves ("spin-transfer term can amplify or attenuate the precession amplitude", see p. 3151; see also p. 3151, "current bias of proper polarity can excite uniformly precessing spin-wave modes").

It would have been obvious to one of ordinary skill in the art at the time the invention was made to direct the current in the claimed direction as taught by Katine et al. The rationale is as follows: one of ordinary skill in the art would have been motivated to attenuate precession amplitude as taught by Katine et al.

As recited in claim 2, Zhu is silent regarding whether the spin polarized current has a direction such that the spin momentum transfer torque opposes an intrinsic damping torque in the free layer.

See teachings, rationale, and motivation for combining teachings above for claim 1.

As recited in claim 4, Zhu shows that pinning a magnetization of the reference layer comprises exchange coupling an antiferromagnet (AFM, see p. 7273, section II) to the reference layer (CoFe(20)/Ru(6)/CoFe(18)).

As recited in claim 8, Zhu shows that the spacer layer is a nonmagnetic metallic spacer layer (Cu(18)).

As recited in claim 12, Zhu shows that the reference layer is a layer within a synthetic antiferromagnet (CoFe(20)/Ru(6)/CoFe(18), see p. 7273, section II).

As recited in claim 13, Zhu shows a magnetoresistive (MR) element comprising: a reference layer (including CoFe(20), see p. 7273, section II) having a magnetization pinned in a fixed direction; a free layer (including CoFe(10)) having a magnetization which rotates in response to an external magnetic field; a spacer layer (Cu(18)) positioned between the reference layer and the free layer; and a circuit ("sense currents").

As recited in claim 13, Zhu is silent regarding providing a current perpendicular to a plane of each of the layers in a direction that causes a reduction in thermally activated spin wave noise.

As recited in claim 13, Katine et al show providing a current perpendicular to a plane of each of the layers in a direction that causes a reduction in thermally activated spin wave noise ("depending on the sign of *I*, spin-transfer term can amplify or attenuate the precession amplitude", see p. 3150; see also p. 3151, "current bias of proper polarity can excite uniformly precessing spin-wave modes").

It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the current in the claimed direction as taught by Katine et al. The rationale

is as follows: one of ordinary skill in the art would have been motivated to provide the current in the claimed direction in order to attenuate precession amplitude as taught by Katine et al.

Regarding claim 14: See above for claim 2.

As recited in claim 16, Zhu shows that the spacer layer is a nonmagnetic metallic spacer (Cu(18)).

As recited in claim 19, Zhu shows that the reference layer is a soft ferromagnetic layer (including CoFe(18)) exchange coupled to an antiferromagnet (AFM).

As recited in claim 20, Zhu shows that the reference layer is a soft ferromagnetic layer exchange coupled to a permanent magnet ("spin valve head modeled is stabilized with the abutted permanent magnet scheme", see p. 7273).

As recited in claim 22, Zhu inherently shows an external circuit source.

As recited in claim 34, Zhu shows a method of sensing magnetically encoded information from a magnetic storage medium, the method comprising causing relative motion of the storage medium (such relative motion between head and medium is inherent to "hard disk drives", see p. 7273, section I) with respect to a magnetoresistive (MR) element ("spin valve head", see p. 7273, section II); and detecting a voltage ("signal", see p. 7273, section I) across the MR element.

As recited in claim 34, Zhu is silent regarding the MR element being a current perpendicular to plane (CPP) MR element; and directing a spin polarized current through the CPP MR element in a direction which exerts a spin momentum transfer that reduces noise due to thermally activated spin waves.

As recited in claim 34, Katine et al show a current perpendicular to plane (CPP) MR element (see I in Fig. 1); and directing a spin polarized current through the CPP MR element in a

direction which exerts a spin momentum transfer that reduces noise due to thermally activated spin waves ("depending on the sign of *I*, spin-transfer term can amplify or attenuate the precession amplitude", see p. 3150; see also p. 3151, "current bias of proper polarity can excite uniformly precessing spin-wave modes").

It would have been obvious to one of ordinary skill in the art at the time the invention was made to direct a spin polarized current through the MR element of Zhu perpendicular to the plane, in a direction which exerts a spin momentum transfer that reduces noise due to thermally activated spin waves as taught by Katine et al. The rationale is as follows: one of ordinary skill in the art would have been motivated to attenuate a precession amplitude and to excite uniformly precessing spin-wave modes as taught by Katine et al.

5. Claims 3, 15 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhu ("Thermal Magnetic Noise and Spectra in Spin Valve Heads", 15 May 2002, J. Applied Phys., v. 91, no. 10, pp. 7273-7275) in view of Katine et al ("Current-Driven Magnetization Reversal and Spin-Wave Excitations in Co/Cu/Co Pillars", 3 April 2000, Phys. Rev. Let. v. 84, no. 14, pp. 3149-3152) as applied above, and further in view of Heinonen et al (US Pat. No. 6781801 B2).

As recited in claims 3 and 15, Zhu is silent regarding whether directing a spin polarized current comprises passing a current through a ferromagnetic material, the ferromagnetic material acting as an electron spin filter that polarizes conduction electrons in the current.

Heinonen et al show a spin valve (including FM layer 46, see Fig. 2) acting as a spin filter that polarizes conduction electrons in current ("reference layer 46, and second pinning layer 48 acts as an electrode to spin polarize the sense current", see col. 4, lines 10-17).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to add the ferromagnetic material of Heinonen et al to the element of Zhu as taught by Heinonen et al. The rationale is as follows: one of ordinary skill in the art would have been motivated to add the ferromagnetic material to the element as part of a spin valve to act as a spin filter to polarize conduction electrons in the current so as to significantly enhance an MR effect without appreciably increasing the RA product as taught by Heinonen et al (see col. 4, lines 21-26).

As recited in claim 18, Zhu is silent regarding a tunnel barrier layer.

As recited in claim 18, Heinonen et al show a tunnel barrier layer 40.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to replace the spacer with a tunnel barrier layer as taught by Heinonen et al. The rationale is as follows: one of ordinary skill in the art would have been motivated to replace the spacer with a tunnel barrier layer in order to reduce operating power and to reduce heating as is notoriously well known in the art.

6. Claims 6-7 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhu ("Thermal Magnetic Noise and Spectra in Spin Valve Heads", 15 May 2002, J. Applied Phys., v. 91, no. 10, pp. 7273-7275) in view of Katine et al ("Current-Driven Magnetization Reversal and Spin-Wave Excitations in Co/Cu/Co Pillars", 3 April 2000, Phys. Rev. Let. v. 84, no. 14, pp. 3149-3152) as applied above, and further in view of Dill et al (US Pat. No. 6114719)

As recited in claims 6 and 7, Zhu is silent regarding whether a magnetization of the free layer is parallel or antiparallel, respectively, to the magnetization of the reference layer in a quiescent state.

As recited in claims 6 and 7, Dill et al show that a magnetization of the free layer is parallel or antiparallel, respectively, to the magnetization of the reference layer in a quiescent state ("For a memory cell application one of the ferromagnetic layers in the MTJ has its magnetic moment fixed or pinned so as to be either parallel or antiparallel to the magnetic moment of the other free or sensing ferromagnetic layer in the absence of an applied magnetic field within the cell", see col. 2, lines 18-22).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to set the free layer of Zhu parallel or antiparallel to the reference layer in a quiescent state as taught by Dill. The rationale is as follows: one of ordinary skill in the art would have been motivated to set the layers parallel or antiparallel when quiescent in order to apply the MR element to a memory cell application as taught by Dill et al.

As recited in claim 18, Zhu is silent regarding a tunnel barrier layer.

As recited in claim 18, Dill et al show a tunnel barrier layer 120.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to replace the spacer with a tunnel barrier layer as taught by Heinonen et al. The rationale is as follows: one of ordinary skill in the art would have been motivated to replace the spacer with a tunnel barrier layer in order to reduce operating power and to reduce heating as is notoriously well known in the art.

Allowable Subject Matter

7. Claims 5, 9-11 and 21 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

8. Claim 17 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Ansermet ("Classical Description of Spin Wave Excitation Currents in Bulk Ferromagnets", March 2004, IEEE Transactions on Magnetics, v. 40, no. 2, pp. 358-360) teaches that "it is not necessary to inject polarized spins in a ferromagnetic nanostructure in order to flip its magnetization, but that the current can aid the bias field to reverse the magnetization" (see p. 360).

Weber et al ("The Ferromagnetic Spin Filter", September 1999, IEEE Transactions on Magnetics, v. 35, no. 5, pp. 2907-2909) disclose a spin-polarized scattering experiment.

Seigler et al (US PAP No. 2003/0206380 A1) show a GMR multi-layer wherein the sense current is used to induce spin-momentum transfer from one FM layer to the next FM layer to cause the magnetization of these layers to align 90° with respect to each other, thereby providing the proper biasing of the sensor (see ¶ 0020), wherein "The purpose of the spin polarizing layers is to orient the electrons passing though (*sic*) the polarizer with the same spin to maximize the spin momentum transfer. Spin polarizers may be used on both sides of the device to effect (*sic*) not only transmitted electrons but also electrons which are reflected back into the device. If the spin polarizing layer is chosen and positioned properly, the transmitted electrons could bias the

sensor in one direction (up) and the reflected electrons could bias the sensor in the other direction (down) yielding a differential type sensor" (see ¶ 0029).

Huai et al (US PAP No. 2005/0041342 A1) show a magnetoresistive element having reduced spin transfer induced noise; however, the reference was filed after Applicant's effective filing date.

10. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Julie Anne Watko whose telephone number is (571) 272-7597. The examiner can normally be reached on Mon, Tue, Thu & Fri until 4:45PM, Wed until 3:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William R. Korzuch can be reached on (571) 272-7589. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Julie Anne Watko
Primary Examiner
Art Unit 2653

September 23, 2005
JAW